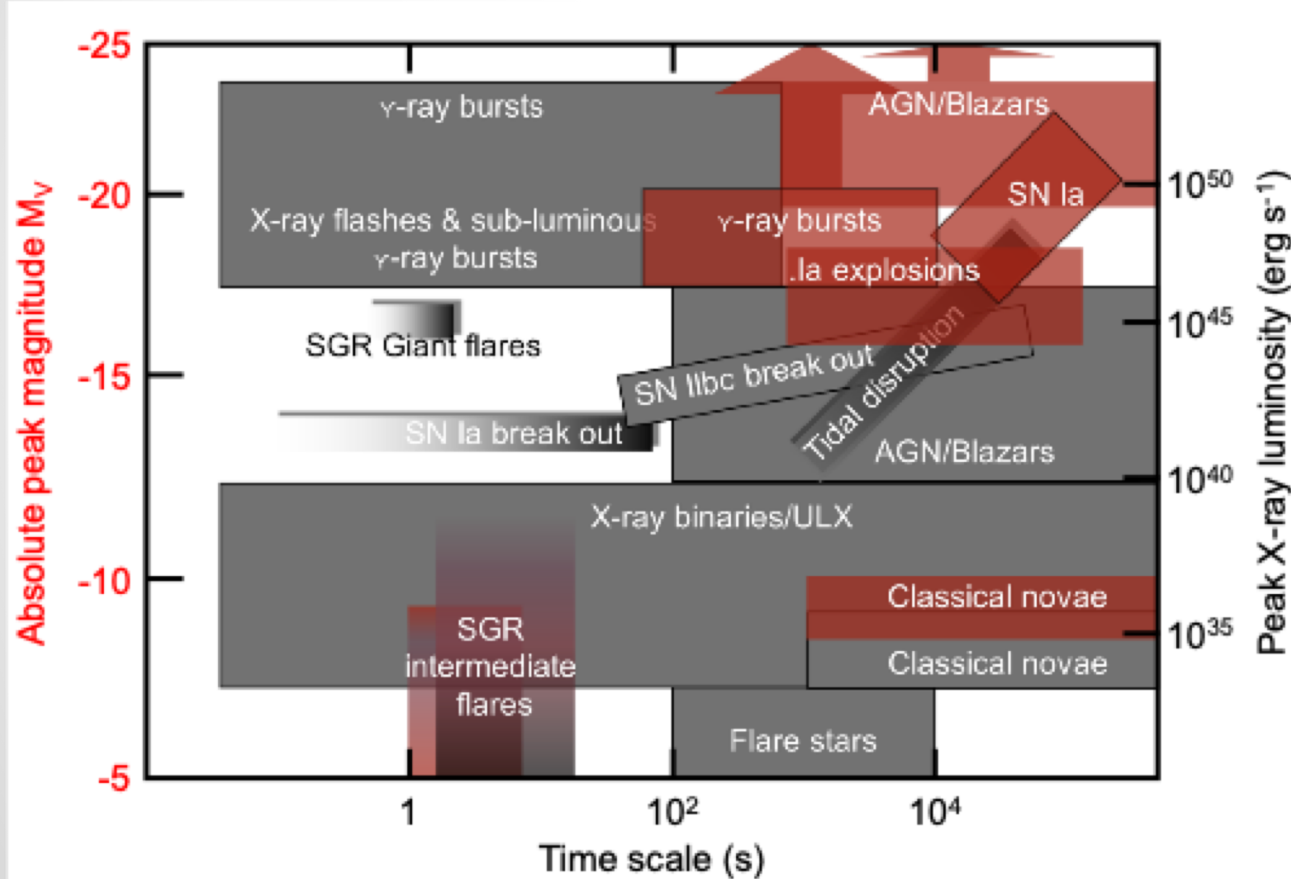


FINK : Follow-up of GRB (and GW) counterparts



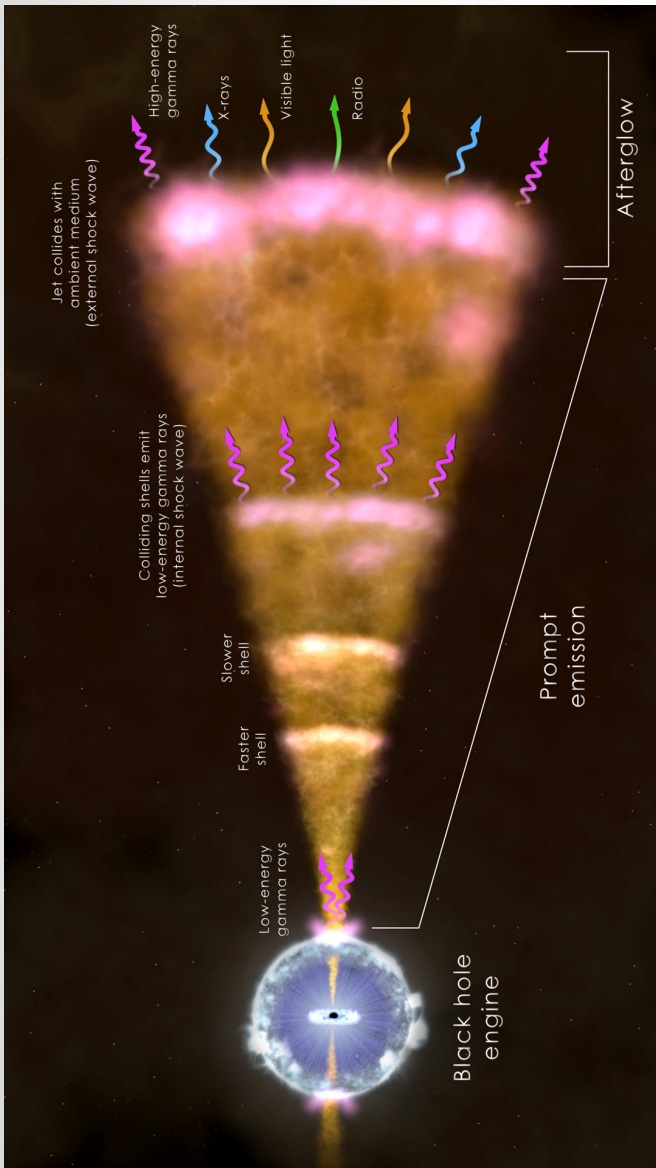
Nicolas Leroy – IJCLab
Journées LSST France – January 2020

Time domain astronomy

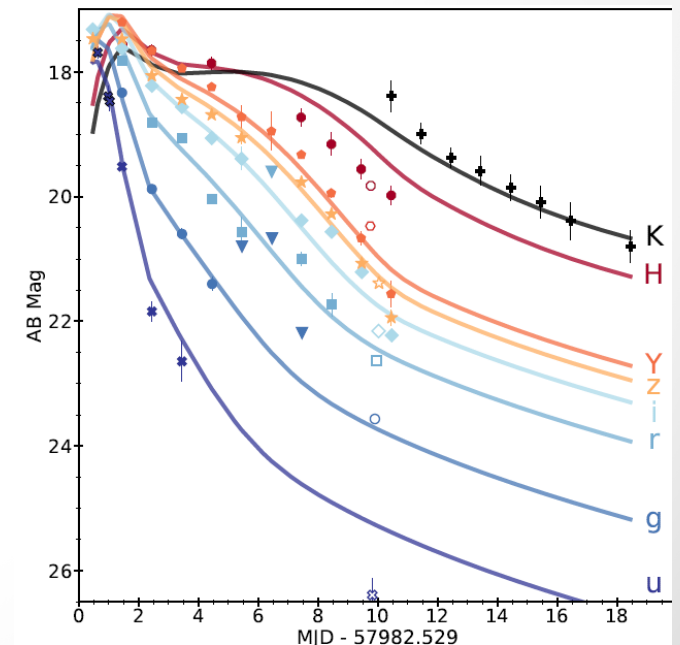
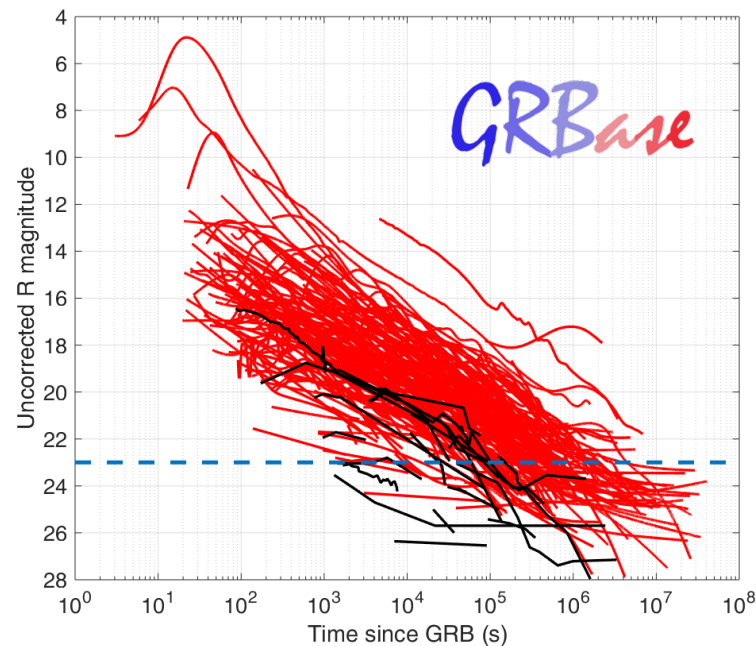


- ✦ Time-domain astronomy is a priority area of research in the next decade
- ✦ Hot topics: explosive transients (GRBs, SN shock breakouts, FRB, ...)
- ✦ Possible GW emitters (and neutrinos)
 - ✦ GW170817 !

Gamma-rays bursts

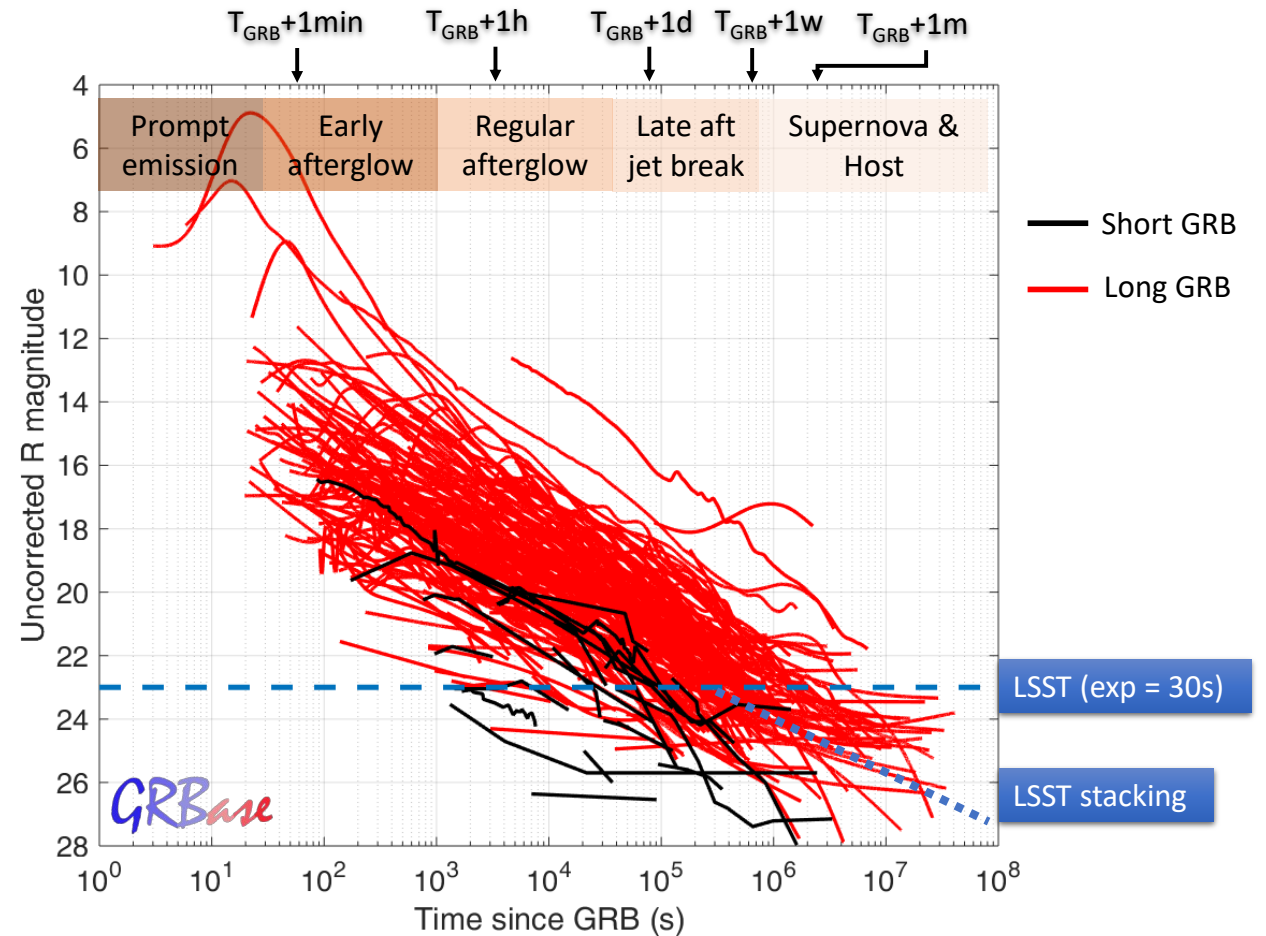


- Prompt emission close the the central engine
 - keV-MeV
- Afterglow emission from the jet
 - From X-rays to radio
 - Trace different phenomena
- Possible kilonovae emission from UV to IR



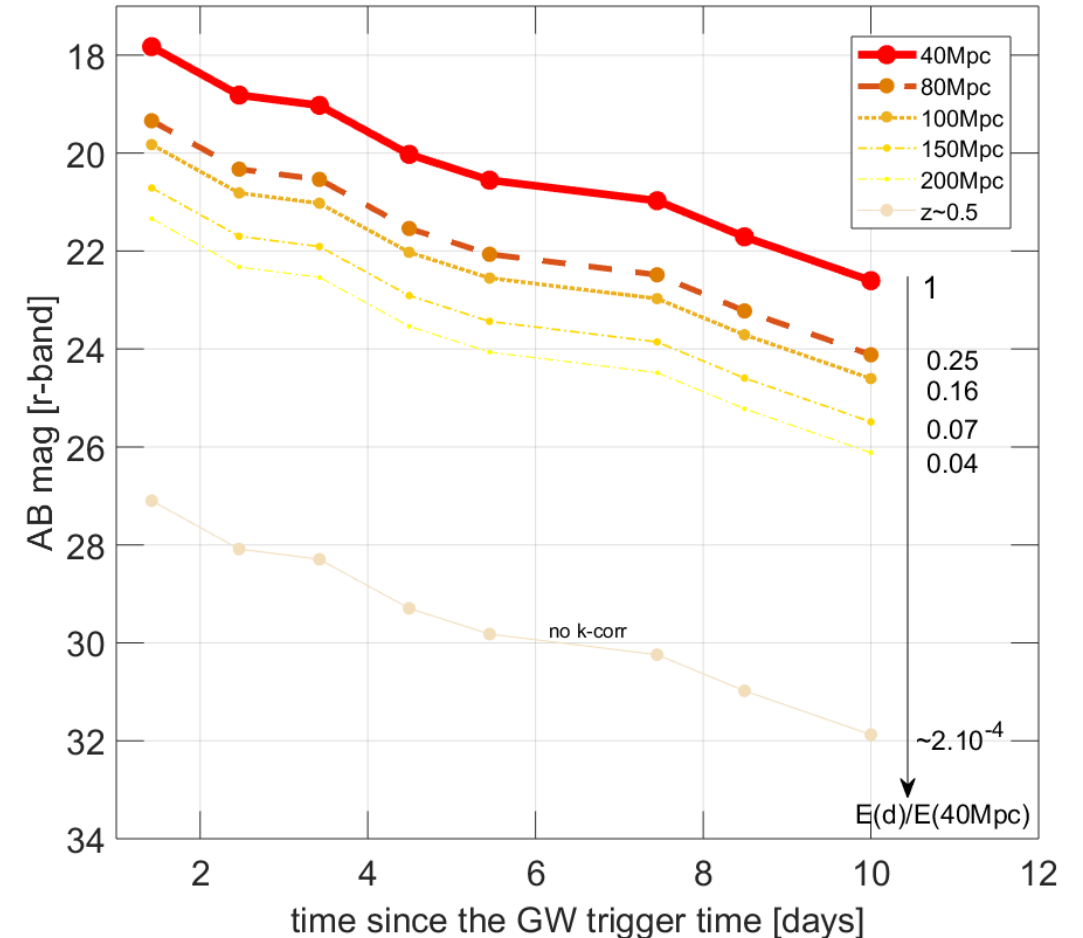
GRB physics

- Prompt/Early afterglow : first time after the burst, can we probe the emission at very early stage of the jet
- Reverse shock physics : jet launch and initial conditions
- Central engine activity
- Relativistic shock physics
- Interaction with ISM
- Study physics of the hosts

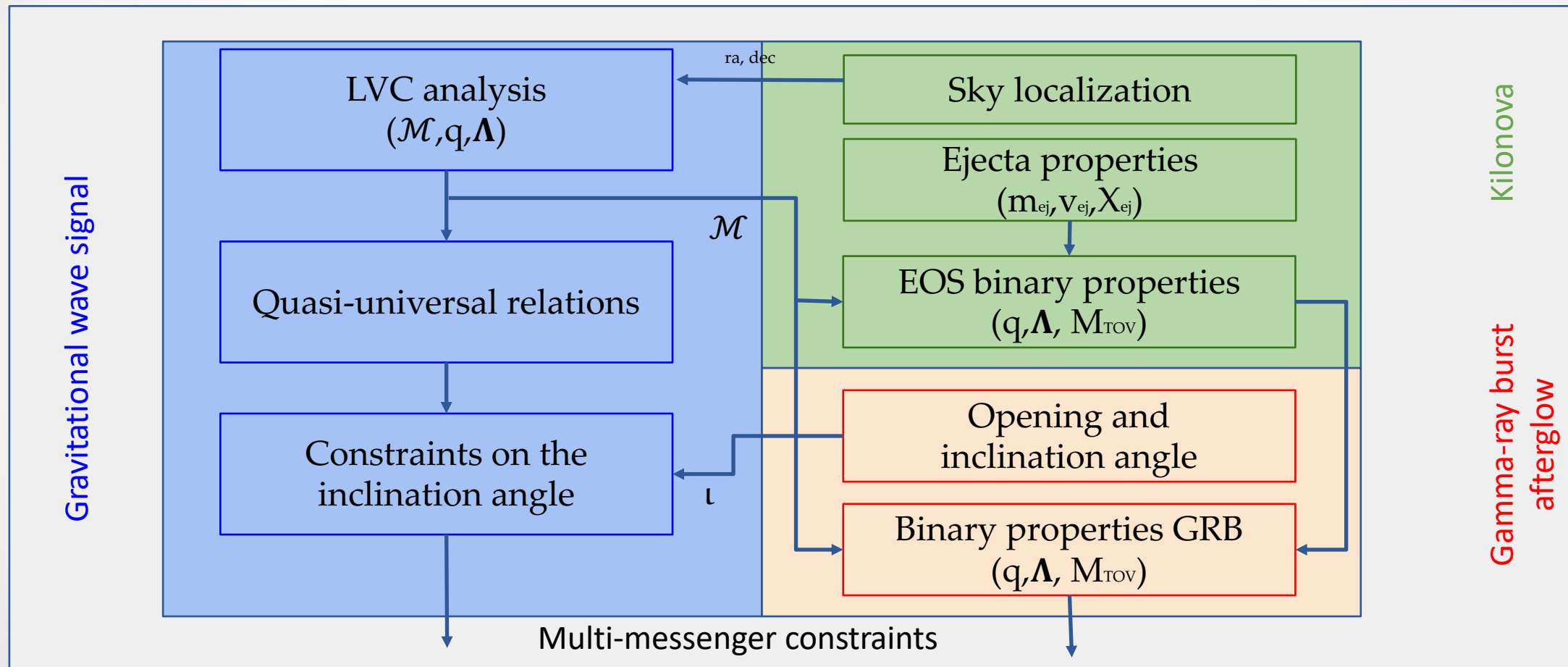


Kilonova

- During merger phase rich neutrons matter could produce heavy elements by neutron capture (r-process)
- Quasi isotropic emission, heated by radioactivity, emission expected to shift from blue to red during cooling
- Ejecta physics and nuclear equation of state
- LSST can catch the signals during 6 days up to 200 Mpc
 - Close to mean distance reachable after 2022

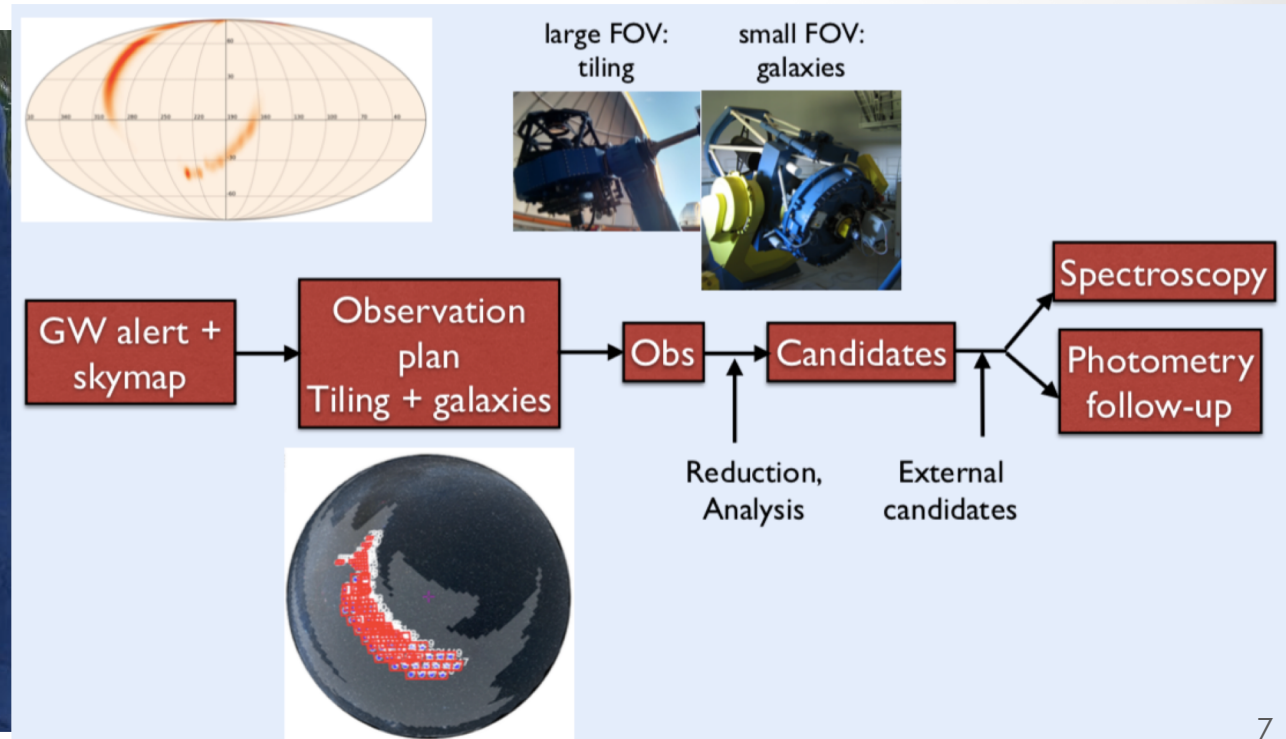
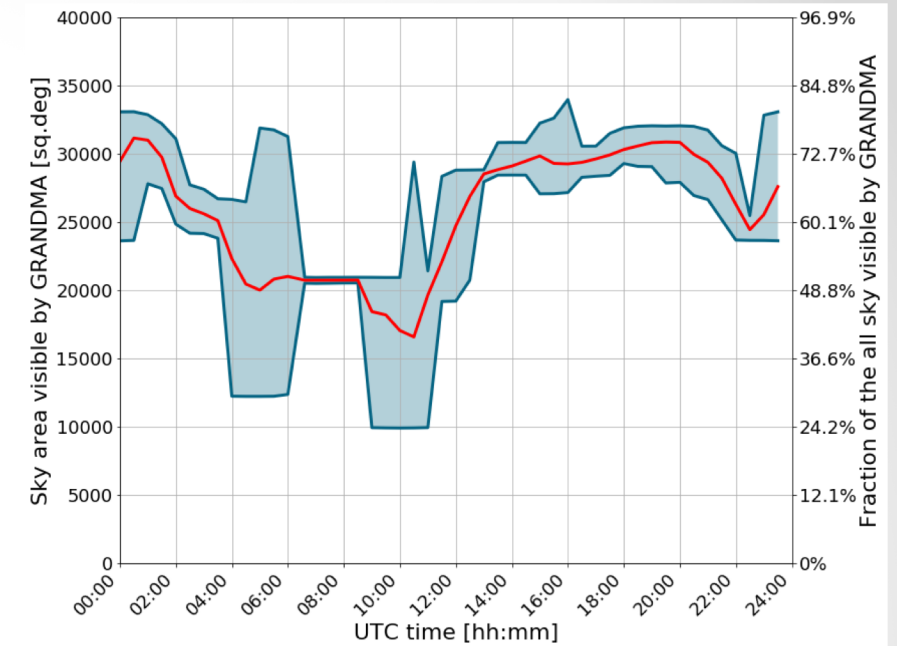


Links between observables



GRANDMA

- Network of telescopes from robotics to follow-up facilities with spectroscopy capabilities
- Optimize observation scheduling and follow-up
- Perform characterization of candidates

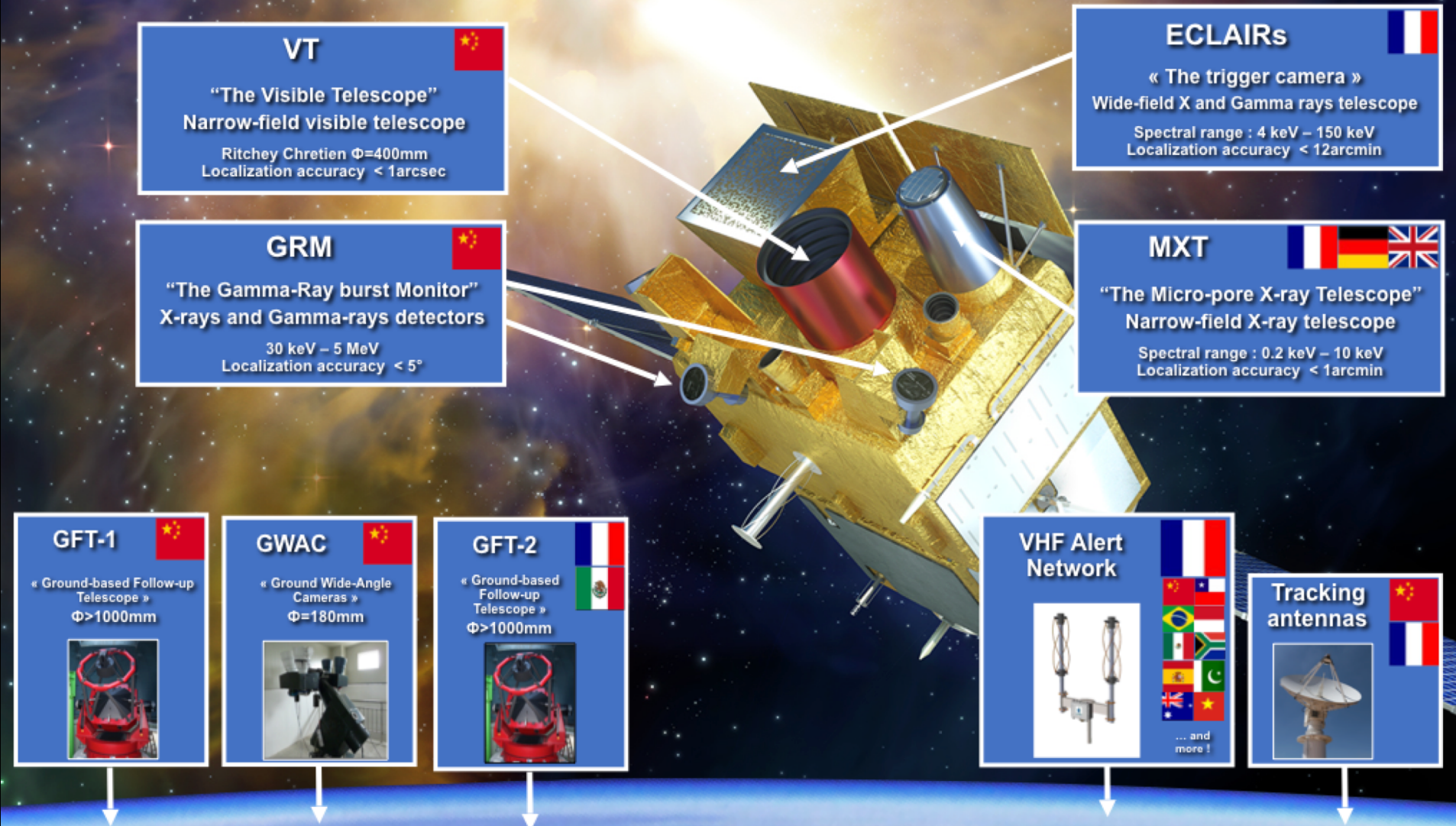


FINK and GRANDMA

- LSST will provide infos for the different candidates that can be observed by the network
 - Help in finding the real counterpart by adding points in the light curve
 - Need to study specific filters
 - Can follow-up also several candidates in parallel
- Optimization on the scheduling to be studied within the framework of FINK
 - Bring new information to prioritize scheduling or follow-up
 - Dynamical scheduling need to be studied
 - Similar technology could be use to speed-up observation plan generation in the network

SVOM "Space-based multi-band astronomical Variable Objects Monitor"

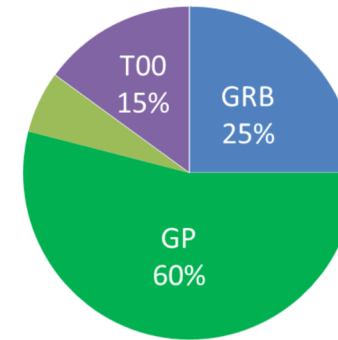
a Sino-French mission dedicated to GRBs and transient sources - Multi-wavelengths
to be launched end 2021, duration 3+2 years



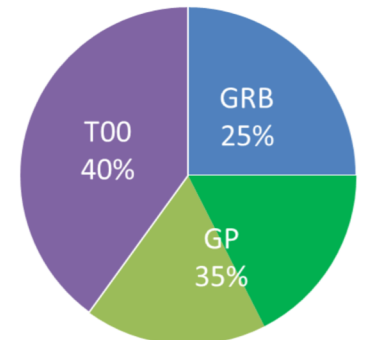
SVOM in the next decade

- SVOM will be one of the main actor on GRB detection after 2021
- Also have an important program on Target of Opportunity
 - From 15 % of time on the first 3 years to 40% after
- LSST is quite complementary with SVOM to study GRBs
 - Help in characterization of counterpart
 - Allow to better study connection with supernovae
 - Add some observations in early phase or latter phase
 - Understand better jet physics

Nominal mission
1 ToO per day, 10% of GP outside B1 law

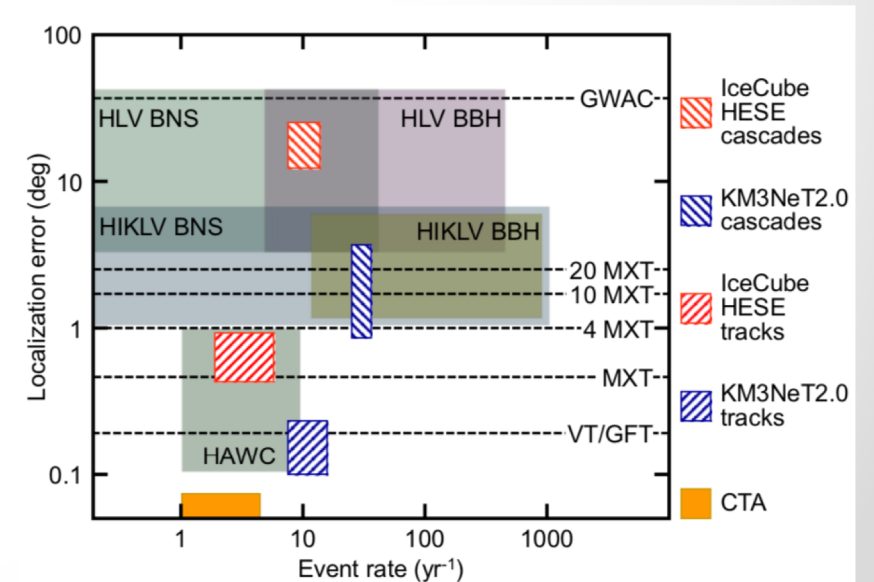
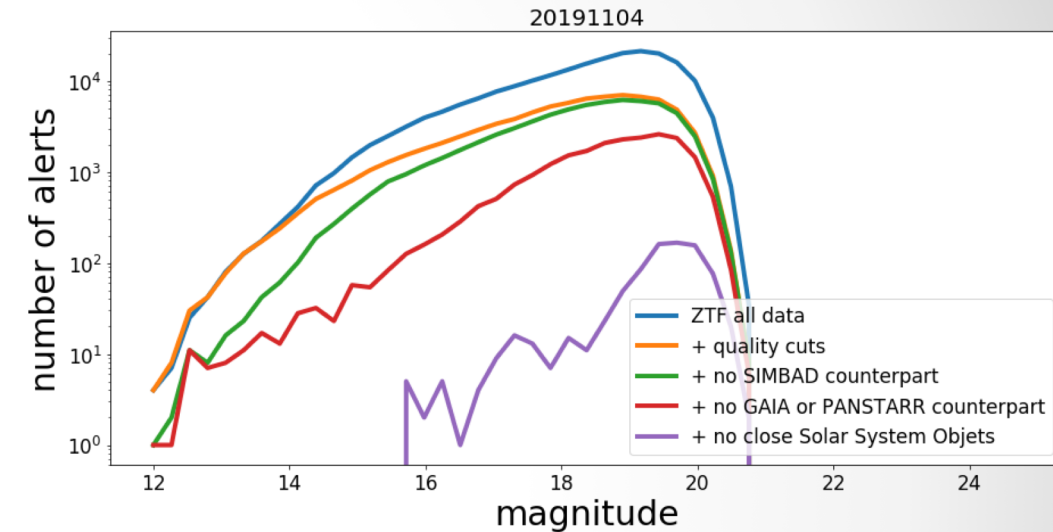


Extended mission
5 ToOs per day, 50% of GP outside B1 law



FINK and SVOM

- ToO program may allow to send 2-3 request per month to satellite
 - Need to filter enough the transient to go for the golden events
- Could also use some of the SVOM ground telescopes with lower threshold
- Could also help in the case of multi-messenger alerts to prioritize the follow-up plan done by the SVOM telescopes
- Help in subthreshold analysis of SVOM data



Conclusions

- FINN and LSST will be key players in the transient astrophysics
- Discussions already started
- Some simulation to be done to simulate GRB afterglows and study effect in LSST data (filters, scheduling, ...)
- Need also to link this with studies using kilonovae
- Will provide more outputs and tools needed